Integrated Water Quality and Aquatic Communities Protocol – Mountain Lakes and Ponds

Standard Operating Procedure (SOP) #10: Multiprobe Usage and Calibration

Draft Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP describes the usage of a multi-parameter probe (hereafter, multiprobe) for the measurement of the four "Core" parameters required by the Water Resources Division for lentic sites: Temperature, Specific Conductance, pH, and Dissolved Oxygen. Additional parameters that the KLMN has included: ORP (Oxidation/Reduction Potential), turbidity, and depth.

Over the course of the monitoring project, multiprobes will wear out, be lost, damaged, or otherwise need replacing. Although a well maintained probe could easily last a decade or longer, the Program Lead should anticipate the need to either upgrade or replace worn-out components on a biennial basis. When probes are upgraded, repaired, or replaced, steps provided in SOP# 16: Quality Assurance Project Plan should be undertaken to ensure data comparability. It is also the responsibility of the Program Lead to ensure that the probes and display units are in proper functioning order a minimum of 3 months prior to the initiation of field work.

The current multiprobes employed by Klamath Network are the *Manta* multiprobe with the *Amphibian* Display, both manufactured by Eureka Environmental Engineering. Although this SOP should assist in many issues that may arise with multiprobe use, occasional assistance or technical support may be necessary. Their web site and support staff should be regularly contacted for upgrades to software and firmware. Their contact information is:

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The user's guides for both the *Manta* and *Amphibian* Display have are included in Appendix J. Also contained in Appendix J is a copy of the help file for the program used to manage data collected by the *Manta* and Eureka PC, along with a help file for iPAQ software version of Eureka Pocket PC interface. The Program Lead and crew should familiarize themselves with all four of these documents prior to multiprobe use. After reading the documents, the Program Lead and crew should begin trials with the multiprobe to insure that all are comfortable using the equipment ***prior to field work***.

The following step-by-step guide to use is not a surrogate for reading the manuals. However, it will fill in the gaps of usage that may not be detailed in the manuals. It also details aspects that are specific to ensuring that data are measured, collected, stored, and managed in identical manner through the life of the project.

Multiprobe Data Collection Step by Step

A. Prior to use, the *Amphibian* and *Manta* components should be checked for proper condition:
    1. The *Amphibian* is a Hewlett-Packard iPAQ model hx2490b pocket PC (hereafter, iPAQ) contained in a waterproof carry case (www.otterbox.com). The container should be inspected for the following (Figure 1).
        a. Intact and clean body O-ring.
        b. Functioning side-clasps.
        c. Intact and clean window O-ring.
        d. Secured and centered iPAQ.
        e. Clean serial port, free of dirt.
        f. Clean and covered round USB/Power Charger port.
    2. The *Manta* Probe should also be inspected (Figure 2).
        a. Check for cracks in acrylic body.
        b. Inspect the integral cable connection (Figure 2). These may crack and need replacing with time.
        c. Check that the serial port is clean and free of dirt.
        d. Check that the O-rings within the acrylic body are making contact (a thin, dark line is visible).
B. Remove the red cap covering the serial port on the *Amphibian* and connect the *Manta* serial port to the *Amphibian*. **Always use the thumb screws to secure the probe to the *Amphibian***. Failure to do so may result in the probe coming off during readings.
C. Once connected, turn on the *Amphibian* by depressing the power button using the stylus attached to the unit (Figure 3).
D. The iPAQ uses Windows Mobile 5.0 operating system for functioning. Crew members should become familiar with this operating system by exploring the functions and settings prior to the field season. It is an intuitive operating system and is interfaced using the stylus to point and depress on-screen items, similar to a point and click interface on a desktop PC. Start the Eureka Software by touching the stylus to the Start menu (Program start button). This should result in a drop-down list of program options (Figure 4). Depress "**eureka**" to start the *Manta* software.

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Figure 1. *Amphibian* overview – top down (Left); open (Right). *Amphibian* parts: A) Neoprene handle; B) Stylus; C) iPAQ pocket PC; D) Top serial port; E) Case clasps; F) External battery; G) Velcro straps to secure iPAQ; H) Circuit board; I) Bottom USB/battery charger port.

Figure 2. *Manta* overview. *Manta* parts: A) *Manta* body; B) Storage cup; C) 25 m cable; D) Waterproof, integral cable connection; E) Marine-grade serial port.

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Figure 3. Hewlett-Packard iPAQ overview, showing relevant buttons to *Manta* multiprobe function.

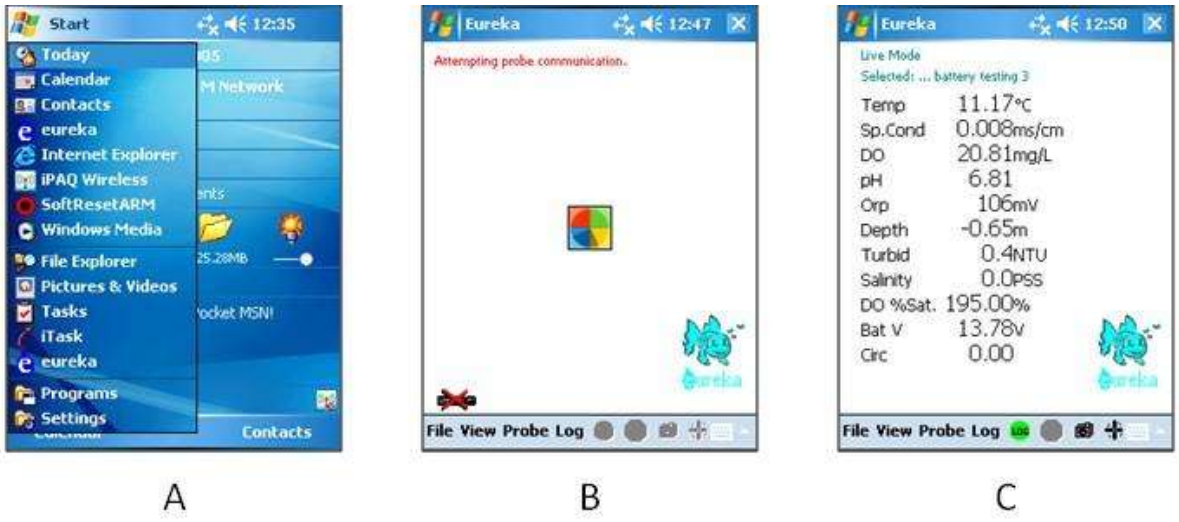

Figure 4. (A) iPAQ start up screen after depressing start; (B) Eureka Start-up; (C) Eureka after probe connection.

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E. Alternatively, the Eureka software can be started by depressing the "hotstart" button on the bottom left of the iPAQ (Figure 3).
F. Once started, the software will attempt to communicate with the *Manta* Probe. If a multi-color symbol appears, communication is being attempted (Figure 4b). Upon connection, data readouts will appear (Figure 4c).
G. It is now possible to proceed with the calibration steps (see below section on Calibration).
H. Before data collection, a proper file must be created in Eureka to store the data in (Figure 5a-c).
    1. Under the "**Log**" menu, depress "**Locations**." Do not use the "" button (Figure 5a).
    2. Depress the "**New**" screen, so that there is an active cursor (Figure 5b).
    3. Depress the keyboard icon at the bottom of the screen to create a new "**Location**" (Figure 5c).
        a. Using the shift key so that capitals and underlines can be used in the file name structure, proceed to tap the keyboard to create the name.
        b. **The file name structure should be:** **Park_Lake_Name_GRTSCode_Year**. Example: **LAVO_Bathtub_Pond_008_2008**. In this example, the name of the habitat is Bathtub Pond, the GRTS code is #008, and it was sampled in 2008, and it is in Lassen Volcanic National Park.
        c. **DO NOT ABBREVIATE** due to time constraints. "**Lake_1_08**" is not an acceptable file name. Note: Files may (and should) be created ahead of time, either by the crew or the Program Lead. Note that the list will indicate if a file has been "**used**" or is "**empty**."
        d. Once the file is created, highlight it by selecting it from the list and depress "**Select**."
I. Once the proper location file is selected, logging a data file can commence.
    1. Ensure that the proper location file is being used; it is indicated at the top of the data readout screen, in small blue text. For example, in Figure 5a, the active location file is "**battery testing 3**." If this is not the proper file, return to the log screen and select the proper file.

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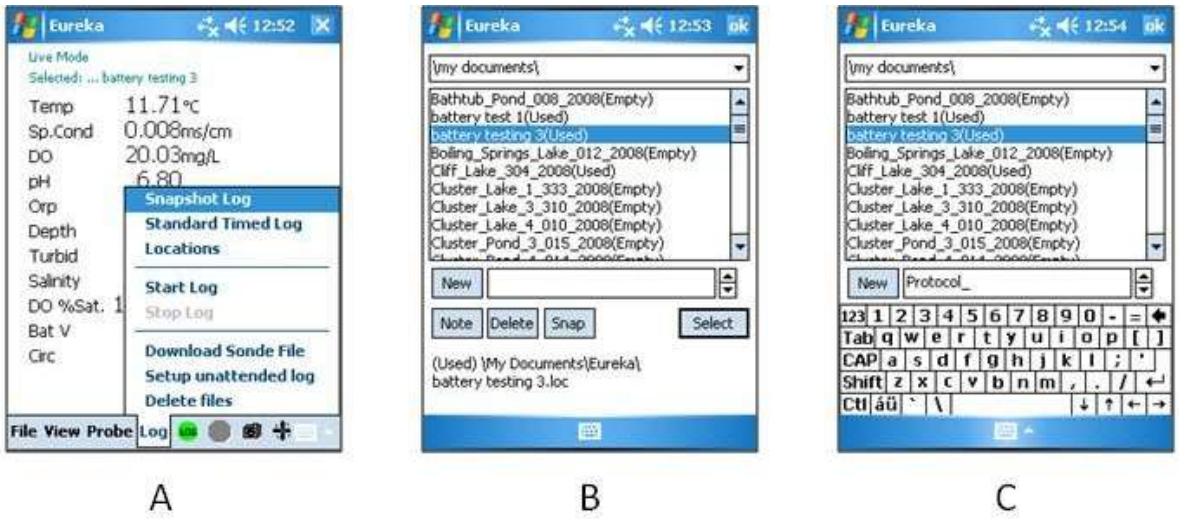

Figure 5. (A) Eureka screen captures for creating "**Location**" files, under "**Log**" command; (B) Selecting an existing "**Location**" file or creating new "**Location**" files; (C) Using keyboard function to name "**Location**" file.

J. At this point, depress the "**Log**" menu option, NOT the green log logo "". This will allow the options shown in Figure 5a.

K. Select "**Standard Timed Log**" from the list. A screen (Figure 6c) giving you the option of select the logging interval comes up; **choose an interval of 1 sec**. This should be the default.

L. Select "**Start Log**." If the "**location**" file is empty, you will have the option to add an annotation or to store the file without annotation (Figure 6b). There should be no need to annotate. Choose "**Store**."

M. If you have chosen a "**Location**" file with existing data, you will receive the option of "**Append**" or "**Overwrite**" (Figure 6c). In most situations, this will indicate that you are using the wrong "Location" file. Depress the "**X**" to cancel out and reselect the proper "location" file as in step H.3.d (above).

N. If everything is done correctly, the Eureka program will return to the data display screen (Figure 4c), but a flashing "" symbol will be in the lower left corner of the display.

O. When you are done collecting data for the lake or pond, select the "" to stop the data logger. Congratulations!

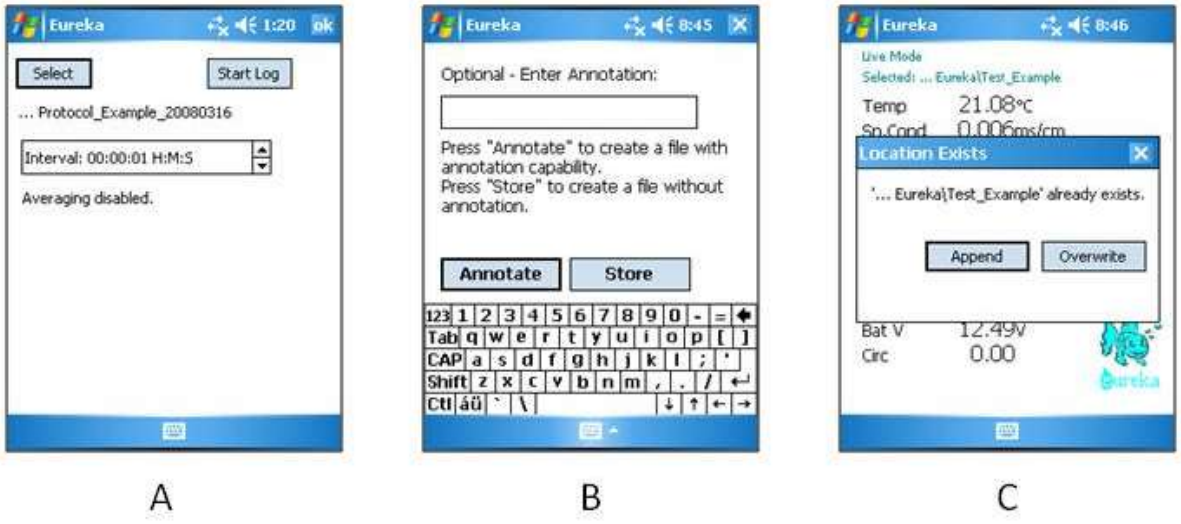

Figure 6. Eureka screen captures for initiation of data logging: (A) Setting the logging interval; (B) Annotation option; and (C) Appending or overwriting an existing file.

Lake/pond Profile Step by Step

With the basic instructions on how to collect data, the following steps should be followed in collecting a lake profile.

A. While on shore, check the calibration of Dissolved oxygen (% saturation), pH, and conductance, and if necessary, recalibrate, following the steps outlined in "Calibration Step by Step." Calibrate the depth.
B. Connect the *Amphibian* to the *Manta* while on shore; replace the storage cup with the weight (Figure 7).

Figure 7. After removal of storage cup, weighted cup on left is attached by screwing into the *Manta* body. Note that the weight is heavy and exerts leverage. Use a firm grasp so that the weighted cup does not interfere or break any of the probes.

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C. Using the inflatable boat, return to the deepest portion of the lake, where the water sample and secchi depth were collected. Use a hand held sonar to confirm depth. Deploy anchor bag if necessary.
D. Turn on the unit and allow it to warm up while in the water on the side of the raft.
E. Confirm that the depth reading is 0.05 m or less, when probe end is just submerged. **If it is not, recalibrate**.
F. Turn on the circulator by depressing the "  " button. Alternatively, the circulator option can be accessed by depressing "**Probe**" menu option, followed by "**Circulator**." When the circulator is active, the data readout screen (Figure 4c) will display "**Circ 1.00**." **Note that if the circulator is not turned on, the dissolved oxygen readings will be inaccurate.**
G. With the probe tip at the surface, wait until all readings appear stable, especially the dissolved oxygen. This may take 1 minute or more. Look for a point where the dissolved oxygen in mg/l fluctuates back and forth (e.g., 9.89 to 9.88 to 9.89, etc.).
H. When the numbers have stabilized, lower the probe a half meter (e.g., 0.00 m to 0.50 m). Repeat the stabilization process in G. above.
I. Continue lowering the probe until stabilized readings have been taken every 0.5 m to the bottom of the lake.
J. Bring the probe back to the surface and shut it down.
K. When shutting it down, be sure to exit and close the program. Turning the unit off without shutting down will cause the program to continue to draw power from the batteries.
L. Remove the weighted cup and replace it with the storage cup. The storage cup should be approximately 1/3 full. It is not necessary to fill it completely.
M. Download the data file to the computer and archive according to instructions in SOP #12: Post-Site Tasks.

Calibration Step by Step

Regular calibration is an important component of maintaining quality control on data collected. The calibration, calibration check, and acceptable range schedule for each parameter should be followed as in Table 1.

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Table 1. Calibration guidelines for *Manta* multiprobe. The probe should be calibrated at the beginning of the work week. When calibration checks are outside the acceptable range (compared to reference solutions), the probe should be recalibrated in the field. (NIST - National Institute of Standards and Technology).

Parameter	Calibration Interval	Calibration Check	Acceptable Range	Notes
Conductance	1/week	per sampling site	± 5 µS/cm	
Dissolved Oxygen (% Saturation)	1/week	per sampling site	± 5%	Calibration is best done the day before deployment, in case the membrane must be replaced.
pH	1/week	per sampling site	± 0.3	
Redox (ORP)	1/week	NA	± 40 mV	
Temperature	NA	1/month	± 0.3 °C	Temperature is factory calibrated, however checks against a NIST thermometer should be done 1/month.
Turbidity	1/week	NA	± 3%	

In general, the probe should be calibrated the day or evening before a work week commences. The probe should be calibrated in the five main parameters, regardless of whether or not it is in the "acceptable range." When in the field, prior to measurement, a quick check against a known solution or another reliable probe should be done. If the parameter measurement is outside the acceptable range, the technician should recalibrate prior to making measurements. Note: it is recommended that the check be against a calibration solution, ensuring that the technician has calibration solution on hand to recalibrate if necessary. **Record results of calibrations and calibration checks on the appropriate logsheet (Appendix F).** Additionally, although the calibration may require a multi-point calibration, the calibration check can be against a single value, as close as possible to the anticipated measurement value.

Generic Calibration Step by Step

A. Attach *Manta* to *Amphibian* as above for multiprobe data collection step by step.
B. Once operating and probe is reading (as in Figure 4c), remove the storage cup and replace with the calibration cup (Figure 8).

Figure 8. Calibration cup with black covering used for calibration procedure.

C. At this point, the probe must be maintained "upside-down" or in an inverted state until calibration is complete.
D. Tap on "**Probe**" menu option, followed by "**Calibration…**" **(**Figure 9a). From the drop down list, select the parameter to be calibrated (Figure 9b).
E. Once selected, tap the appropriate number of calibration points:

Parameter	# of calibration points	Calibration points
Depth	1	@0.00 m for 1 second
Dissolved oxygen (%saturation)	1	@100.00% for 60 seconds
pH	3	@7.00, 4.00, 10.00 for 60 seconds
Redox (ORP)	1	@0.00mV for 1 second
Specific conductivity	1	@58.64ms/cm for 60 seconds
Turbidity	2	@0.00 and 100.00 NTU for 60 seconds

F. Choose the appropriate options (e.g., for pH: "**@7.00 for 60 seconds**").
G. Prior to initiating (by tapping "**Calibrate**"), rinse the probes with a wash bottle of deionized water, shake dry, and fill with the appropriate calibration solutions, so that the probe is covered.

   a. If doing dissolved oxygen, do not fill the cup. Rather, fill until just below the dissolved oxygen probe. Place the black rubber cap on top of calibration cup and let the probe equilibrate for 3 or 4 minutes. This creates a 100% saturated air pocket with in the atmosphere.

   b. If doing depth, there is no "solution." Simply run the calibration while holding the probe in the air along the shoreline, ensuring that there is water on the probe (shake if necessary).

H. When the appropriate solution is in the cup, and the probe has equilibrated, tap "**Calibrate.**" (Figure 9a). Follow instructions on the *Amphibian* (Figure 9b).
I. When doing dissolved oxygen, be sure to maintain the probe vertical, so that no water gets on the oxygen membrane.
J. Once all calibrations are done, click "**ok**" in the upper right corner. Click "**Yes**" to save the calibrations (Figure 9c).
K. Record results and date and time of calibration on calibration tracking form (Appendix F).
L. Remove calibration cup and replace with storage cup or with weighted cap for data collection.

Dissolved Oxygen Membrane

When calibrating dissolved oxygen, the calibration may occasionally fail, or while using the probe, the operator may notice that an inordinate amount of time may be required for the probe to equilibrate. Both of these are signs that the membrane may be wrinkled, have an air bubble, damaged, or otherwise "gone bad." Such a membrane will need to be replaced, along with

electrolyte solution. For this reason, the field crew should always carry spare membranes and electrolyte solution with them to the field site.

Figure 9. Eureka screen captures for calibrating probe: (A) Selecting parameter; (B) Waiting for calibration stabilization time; and (C) Saving calibration set points.

Excellent instruction on how to replace the membrane is provided in Appendix J, Eureka Environmental *Manta* manual. Both crew members should be trained in membrane replacement. Recalibration will have to be performed after replacement, ideally after a 24 hour period to allow the membrane to relax and stretch. Calibrations after the 24 hour period will be more stable and last longer. If the membrane replacement is done on-site, the calibration is still valid. However, the calibration will not "last," so that if measurements are retaken later in the day (3+ hours, for example), the probe will need to be recalibrated. In other words, the calibration will not "hold" unless it is calibrated 24 hours later. However, accurate readings can still be taken immediately after replacement.